REMARKS

Reconsideration of the subject patent application is respectfully requested. Although this application now stands under FINAL Action, it is hoped that, in view of the prosecution history for this application and in view of the amending changes made to each of the independent claims, the Examiner will be favorably disposed so as to enter this Amendment Response and thereby be afforded the opportunity for the Examiner to give due consideration to these claim amendments and to the remarks which are offered in support of patentability. Specifically, claims 1-19, 24-26, and 31-38 stand rejected under 35 U.S.C. §103(a) as being unpatentable over either Flemings et al. or Kono and further in view of either Winter et al. or JP 1-192,446. In the rejection of these claims, the Examiner has taken the position that Flemings et al. and Kono substantially show the invention as claimed, except that they use a mechanical stirrer instead of an electromagnetic stirrer for forming semi-solid slurry. The Examiner goes on to suggest that both Winter et al. and Japan '446 show that it is conventional to use an electromagnetic stirrer for forming semi-solid slurry in a casting process. The Examiner concludes that in view of the prior art teachings as a whole, it would have been obvious to use the electromagnetic stirrer of Winter et al. or Japan '446 in the die casting process of Flemings et al. or Kono to produce a better and purer cast product.

Additionally, in the FINAL Office Action (referring to page 3), the Examiner comments regarding claims 2-8 and 26 with the following statement:

> "...it would have been obvious to obtain the optimal casting cycle time through routine experimentation."

With regard to claims 9 and 16, the Examiner makes the following statement:

> ". . . it would have been obvious to use a transferring device for delivering molten metal to the vessel when the molten metal was melted at a different location than the caster."

With regard to claims 17 and 18, the Examiner makes the following statement:

> ". . . it is a common practice to either electromagnetically stir the molten metal to cause the same flow circumferentially or longitudinally."

With regard to claim 19, the Examiner makes the following statement:

> ". . . it is conventional to add reinforcement particles into molten metal before casting such that to form a metal matrix composite article if the composite article is designated."

With regard to claim 31, the Examiner makes the following statement:

> ". . . it would have been obvious to change the any power supply parameter to control the strength of the EM field."

With regard to claim 38, the Examiner makes the following statement:

> "... it would have been obvious to arrange any combination of different type of stirrers around the vessel depending on the designated stirring pattern to be obtained."

Although the Examiner very succinctly states that all of these claim elements are, in his opinion, obvious, not one of the four primary references being relied upon for the rejection of claims 1-19, 24-26, and 31-38 actually disclose these claim elements. At a minimum, the Applicants are entitled to the citation of one or more relevant prior art references which actually teach what the Examiner believes to be obvious. It is requested that specific citations of prior art be made for each of these claims and, if not, that these claims be acknowledged as being patentable. Of particular interest to the Applicants is the patentability of dependent claims 2-8 and 26 which establish time interval ranges for each of the recited processing steps. Since none of the cited references make any acknowledgment of time intervals nor make any suggestion with regard to the importance of controlling the time intervals, it is hard to imagine that the precise refinement of this complex process could be achieved through "routine experimentation". If in fact this is as obvious and as routine as the Examiner indicates, then it should not be a problem to provide several relevant prior art references which actually teach the importance of optimizing the individual time intervals for the various process steps.

A further request is for the Examiner to specifically initial off each reference which was considered as part of Applicants' Information Disclosure Citation list. While

the Examiner signed this document on May 7, 2002, and returned a copy with the FINAL Office Action, the individual references which are itemized on that list were not individually initialed off as actually being considered, as is required. Correction and a revised copy of this document, having each entry initialed off by the Examiner, is requested.

With regard to the references relied upon by the Examiner for the rejection of all claims, it is important to first consider the two primary references, Flemings et al. and Kono, and evaluate what is actually disclosed and importantly what is not disclosed by each of those. Considering the structure and method steps disclosed in the Flemings et al. patent, it will be seen that the stirring by means of augers 16, 17, and 18 (see FIG. 1) occurs at a first location within cooling jackets 28, 29, and 32, respectively. The liquid-solid mixture discharged from openings 40, 41, and 42 (by gravity) is next routed to the FIG. 7 structure or to the FIG. 8 structure.

In the FIG. 7 structure, the mixture, subsequent to the stirring step, is transferred to another vessel and from there into the creation of a cylindrical-shaped <u>solid product</u> 80. As such, there is no disclosure, as part of the FIG. 7 embodiment, of discharging the slurry billet "directly and immediately" into a shot sleeve. Further, to be able to subsequently utilize the solid product 80 in any context, it has to be reheated. This reheating step is not a part of the present invention and the specification clearly discloses the disadvantages in trying to achieve the desired microstructure if the solidified product or any portion of that product has to be reheated. This would also cause the time that the mixture is in the cooling jacket 77 to constitute an intermediate holding stage, another feature which is not part of the claimed invention and is specifically excluded.

Whether or not the Flemings et al. structure, according to FIGS. 1 and 7, could be modified with electromagnetic stirring, this would not affect in any way, shape, or form, all of the other significant deficiencies from the claimed invention. Claim1, as amended, recites several method step features which are simply not part of the Flemings et al. structure and process, according to FIGS. 1 and 7 and the corresponding portions of the specification. These differences are unaffected by whether or not there is electromagnetic stirring.

Claim 1, as amended, recites that we begin with a metal alloy and then transfer an amount of that alloy into a vessel and then, by cooling and by electromagnetic stirring, this amount of alloy is transformed into a "slurry billet". The specification of the present patent application clearly supports this transformation, involving partial solidification, into what becomes a discrete, self-supporting volume of alloy. This is why the various discharging arrangements are able to work. If the liquid portion of the slurry billet was of such a proportion so as to cause the alloy to retain all liquid properties and thus behave as a liquid, the discharging arrangements disclosed in the present application would simply not work. The ratio of solids caused by cooling and stirring creates the "slurry billet" which is discharged, with sufficient "structure" to retain its discrete, self-supporting status. Consequently, in order to satisfy claim 1, the prior art must discharge a "slurry billet" from the vessel where both cooling and stirring occur.

In the FIG. 8 structure, the mixture, subsequent to the stirring step, is transferring to another vessel 90, which is described in Flemings et al. as a "holding chamber 90". This holding chamber is provided with "induction heating coils 91" which are activated in order to maintain the desired temperature. Positioned within holding chamber 90 is a

sleeve 92 which is used to transport the composition 93 to the subsequent die casting process.

In the claimed invention (referring now to claim 1), the stirring by way of an electromagnetic field occurs within the vessel and the discharging from this same vessel goes directly and immediately to the shot sleeve. These are claimed elements which are simply not part of the Flemings et al. structure and process of FIGS. 1 and 8. Not only is there an intermediate staging between the stirring vessel and the shot sleeve of the die casting machine, this intermediate stage in the form of chamber 90 is actually called a "holding" chamber. There is also a reheating step by the use of heating coils 91. These are features specifically excluded by the claimed invention.

Whether or not the Flemings et al. structure, according to FIGS. 1 and 8, could be modified with electromagnetic stirring, this would not affect in any way, shape, or form, all of the other significant deficiencies from the claimed invention. Claim1, as amended, recites several method step features which are simply not part of the Flemings et al. structure and process, according to FIGS. 1 and 8 and the corresponding portions of the specification. These differences are unaffected by whether or not there is electromagnetic stirring.

The final embodiment of Flemings et al. is partially disclosed in FIG. 9. The obvious problem with FIG. 9 and the corresponding text in column 8, lines 61-67, and column 9, lines 1-36, is that it is grossly incomplete to the point that it likely teaches nothing.

In FIG. 1, the "agitation zones" are identified as items 10, 11, and 12. What exits from openings 40, 41, and 42 is a liquid-solid mixture. The raising and lowering of the

augers 44, 45, and 46 is used to vary the size of openings 40, 41, and 42 and thereby adjust the flow rate of this liquid-solid mixture.

In FIG. 9, and "opening 54" is identified, but reference number 54 actually refers to an "agitation zone 54" in FIG. 2 as supported by the text in column 6, at lines 27-53. Since "opening 54" is not a part of anything disclosed or illustrated in FIG. 1, and since the corresponding "agitation zone" is not shown as stated in column 8, line 67, there is absolutely no way to tell what type of structure, mechanism or process is actually used to get to the illustrated status of FIG. 9. Effectively, we know nothing about whatever might be located upstream from the FIG. 9 illustration.

The Flemings et al. specification goes on to describe that some portion 101 of mixture 100 just breaks off due to gravitational forces. There is no disclosure as to the amount of that portion that will break off, nor when, nor by what means it is caused to break off. Consequently, there does not appear to be any way to accurately control the amount of material which breaks off and falls between the die halves. Further, there is no shot sleeve disclosed and the concept of "dropping" in between die halves suggests a very simplistic mold design, nothing approaching the complexity and intricate shapes of die casting where the alloy mixture must be forced into the die with substantial pressure in order to get the alloy mixture into all of the small spaces, corners, and intricacies of the die. Simply "dropping" a lump of material between two mold halves clearly does not provide any structure approaching die casting and the use of a shot sleeve.

Considering the structure and method steps disclosed in the Kono patent, there are effectively two embodiments illustrated in FIGS. 1 and 3. However, those features which distinguish the Kono patent from the claimed invention are found in both embodiments.

Claim 1, as amended, recites that we begin with a metal alloy and then transfer an amount of that alloy into a vessel and then, by cooling and by electromagnetic stirring, this amount of alloy is transformed into a "slurry billet". The specification of the present patent application clearly supports this transformation, involving partial solidification, into what becomes a discrete, self-supporting volume of alloy. This is why the various discharging arrangements are able to work. If the liquid portion of the slurry billet was of such a proportion so as to cause the alloy to retain all liquid properties and thus behave as a liquid, the discharging arrangements disclosed in the present application would simply not work. The ratio of solids caused by cooling and stirring creates the "slurry billet" which is discharged, with sufficient "structure" to retain its discrete, self-supporting status. Consequently, in order to satisfy claim 1, the prior art must discharge a "slurry billet" from the vessel where both cooling and stirring occur.

Whether we consider feeder 20 as the "vessel" or barrel 30 as the "vessel", we know that what is discharged by way of opening 27 or ball valve 70 is not a "slurry billet". Instead, what is discharged is a fluid volume which is not discrete nor self-supporting. The use of a ball valve 60 should attest to the liquid nature of the alloy which is discharged into accumulation chamber 50.

Additionally, as is very clearly described in column 4, lines 36-57 of the Kono patent, a volume of metal alloy solidifies in exit port 57 so as to function as a "plug" which must be "reheated" in order to inject alloy into the mold. As has been very clearly described and as claimed, it is metallurgically important to not reheat the solidified alloy or slurry billet as this adversely affects the desired microstructure of what will be injected

into the die. The required reheating in Kono, in order to melt the solidified plug, clearly distinguishes the claimed invention from what is disclosed in the Kono patent.

It is also important to note that in Kono, item 50 is not described as a shot sleeve and is not illustrated as being integrated into a die casting machine. Instead, item 50 is described as an "accumulation chamber" 50. This accumulation chamber includes heating elements 70h and 70i and heating element 80. These are structural features which are not known to be a part of any shot sleeve of a die casting machine. Instead, in the type of die casting process which is consistent with the present invention, there is a rapid injection stroke as soon as the slurry billet is placed in the shot sleeve. This is important for two reasons. First, rapid injection helps to maintain the desired thixotropic composition of the slurry billet as it is injected into the die. Secondly, a rapid injection helps to generate a faster overall die casting cycle so that the rate of parts production by the die casting machine can be optimized. The Kono device does not satisfy or meet this aspect of the claimed invention.

Whether or not the Kono structure could be modified with electromagnetic stirring, this would not affect in any way, shape, or form, all of the other significant deficiencies from the claimed invention. Claim1, as amended, recites several method step features which are simply not part of the Kono structure and process and the corresponding portions of the specification. These differences are unaffected by whether or not there is electromagnetic stirring.

The Examiner's rejection of claims 1-19, 24-26, and 31-38 relies on a combination of either Winter et al. or JP 1-192,446 with either Flemings et al. or Kono. According to the Examiner, it would be obvious to transform the mechanical stirring

arrangements of Flemings et al. and Kono with electromagnetic stirring based on the disclosures of Winter et al. and/or JP 1-192,446. However, as the foregoing analysis reveals, there are numerous reasons why the claimed invention is not satisfied by either Flemings et al. or Kono, regardless of whether or not electromagnetic stirring is added. Even if the contended obviousness of this combination would be conceded, which it is not, the resulting combination still does not meet or satisfy all of the elements of the claimed invention.

Considering the use of Winter et al. and JP 1-192,446 in combination with Flemings et al. and/or Kono, it should be noted that Winter et al. makes no disclosure of any structure. The only drawings are two micrograph illustrations. Consequently, there is no "teaching" of any structure which could be relied upon by a person of ordinary skill in the art to guide their design efforts. Even if this hypothetical person would select Winter et al. to combine with Flemings et al. or Kono, there is nothing actually taught by Winter et al. as to how this combination should be effected. Neither Flemings et al. nor Kono disclose any awareness of electromagnetic stirring so they cannot offer any guidance as to where or how electromagnetic stirring would be added or even if it could be added.

While Winter et al. is believed to be lacking as far as any definitive teaching of the required structure, there are a few structural statements. For example, in column 3, lines 64-68, and in column 4, lines 1-7, it is stated that the preferred embodiment is to use a separate AC induction coil around the outlet passage from the stirring chamber. The design is to simply hold the molten metal in the chamber or allow it to "continuously flow out" at the desired rate. If this part of the Winter et al. design is interpreted to be part of the required electromagnetic stirring structure, then this would mean that

additional changes would have to be made to Flemings et al. and/or to Kono in order to accommodate this combination. While there is this limited disclosure for controlling the "flow out" rate, even less is described for exactly how the overall structure for electromagnetic stirring would be integrated into the remainder of the apparatus. Also of note is the fact that Winter et al. only recognizes and is directed to the continuous flow out of alloy and not the formation of any "slurry billet".

With regard to JP 1-192,446, the most that can be derived from what is illustrated and described is the use of alternating heating and cooling elements which in turn are arranged in an alternating pattern with electromagnetic coils along an inclined trough or barrel. Interestingly, even with the use of coils 6, mechanical stirring is still used at the outlet location. The alloy is discharged as a continuous flow stream, and there is absolutely no disclosure of creating a "slurry billet".

After considering JP 1-192,446, a person of ordinary skill in the art would at most envision the use of electromagnetic stirring in alternating sequence with heating and cooling, all in combination with mechanical stirring such as that provided by the motor driven auger. Why then, would there be any motivation for a person of ordinary skill in the art to consider a <u>total</u> replacement of mechanical stirring with electromagnetic stirring based upon JP 1-192,446 since this reference teaches that you must use both types of stirring mechanisms.

A related shortcoming of JP 1-192,446 is the lack of any guidance as to where or how the electromagnetic coils should be arranged relative to the type of structures disclosed in Flemings et al. and Kono. In Flemings et al., there are heating coils 25-27 around the auger stirring chamber and cooling jackets 28, 29, and 32 outwardly thereof.

The only "teaching" from JP 1-192,446 is to <u>alternate</u> the electromagnetic stirring coils with heating coil 7 and cooling coils 8. It is certainly not obvious (to anyone) as to how the teachings of JP 1-192,446 could be incorporated into the structure of Flemings et al. or even if the teachings of JP 1-192,446 could be incorporated into the structure of Flemings et al.

As far as the Kono patent, and the possible incorporation of the teachings of JP 1-192,446, it should be noted that the actual stirring tip or mixer 32 is at a single location near the bottom of barrel 30. If electromagnetic stirring is actually going to be used to replace the mechanical stirring, in this case by mixer 32, then the only step that might be "obvious" would be to position the electromagnetic stirring coil at the precise location where mechanical stirring occurs. Where is there any suggestion in Kono that stirring must be done along the entire length of barrel 30? Obviously there is no such teaching or suggestion. Therefore, the most that would be "obvious" to a person of ordinary skill in the art is to place an electromagnetic coil around barrel 30 at the precise location of the tip of mixer 32. However, how can this be done in view of the structural interference created by the design and location of cylinder 40? It should be clear that what has been trivialized as a simple and direct substitution is extremely complex, well beyond what might be obvious to a person of ordinary skill in the art.

While it is Applicants' position that it is not obvious to combine the electromagnetic stirring teachings of Winter et al. or JP 1-192,446 with Flemings et al. or Kono, there is a substantial question of whether it is even possible to do so. Since the Examiner is not entitled to reconfigure and redesign the prior art to try and make it "fit" the claim using hindsight knowledge and speculation, we must be guided by what is

actually taught by the prior art, nothing more. Further, even if electromagnetic stirring would be added to Flemings et al. and/or Kono, there are still several very substantial reasons why the independent claims, as amended, do not read on the resulting combination. These reasons have been fully presented as part of this response and the Examiner is respectfully requested to give these proper consideration.

If this Amendment Response is not considered sufficient to place the subject application in condition for allowance, the undersigned attorney of record would appreciate an interview with the Examiner with the added request that the Examiner's Supervisor participate in that interview.

CONCLUSION

Attached hereto are four (4) pages which present a marked up version of the changes made to this application by the current amendment. The first page of the four attached pages is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

It should be understood that the above remarks are not intended to provide an exhaustive basis for patentability or concede the basis for the rejections in the Office Action, but are simply provided to overcome the rejections made in the outstanding Office Action in the most expedient fashion.

In view of the above amendments and remarks, it is respectfully submitted that the present application is in condition for allowance and an early Notice of Allowance is earnestly solicited. If, after reviewing this amendment, the Examiner feels that any issues

remain which must be resolved before the application can be passed to issue, the Examiner is invited to contact the Applicants' undersigned representative by telephone to resolve such issues.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Please amend claims 1, 24, 31, 35, 37, and 38 in the following manner:

1. (Twice amended) A method of producing on-demand, semi-solid material for a casting process, said method comprising the following steps:

heating a metal alloy until it reaches a molten state;

transferring an amount of said metal alloy, while in said molten state, to a vessel;

cooling said amount of metal alloy in said vessel;

applying an electromagnetic field to said amount of metal alloy for creating a flow pattern of said metal alloy within said vessel while said cooling continues in order to create a slurry billet of the desired thixotropic solid to liquid ratio for casting; and

discharging said slurry billet from said vessel, directly and immediately, into a shot sleeve of a casting machine, without any intermediate stage of holding said slurry billet between said vessel and said shot sleeve and without any reheating step subsequent to said discharging from said vessel.

24. (Amended) A method of producing shaped metal parts from on-demand, semi-solid metal with degenerate dendritic primary solid particles, said method comprising the following steps:

heating a metal until it reaches a molten state;

transferring an amount of said molten metal to a vessel, while controllably cooling said amount of molten metal in said vessel;

applying an electromagnetic field to said amount of molten metal for creating a flow pattern of said molten metal within said vessel until a desired molding temperature within the semi-solid range is reached, thereby creating a slurry of the desired thixotropic solid to liquid ratio for casting; and

discharging said slurry billet from said vessel, directly and immediately, into a shot sleeve of a casting machine, without any intermediate stage of holding said slurry billet between said vessel and said shot sleeve and without any reheating step subsequent to said discharging from said vessel.

31. (Amended) A method of producing on-demand, semi-solid material for a casting process, said method comprising the following steps:

heating a metal alloy until it reaches a molten state;

transferring an amount of said metal alloy, while in said molten state, to a vessel;

cooling said amount of metal alloy in said vessel;

applying an electromagnetic field to said amount of metal alloy by the use of a stator for stirring said metal alloy within said vessel while said cooling continues in order to create a slurry billet of the desired thixotropic solid to liquid ratio for casting, a voltage being applied to said stator, the level of said voltage determining the stirring torque applied to said metal alloy;

changing the voltage level applied to said stator so as to change the stirring torque applied to said metal alloy; and

discharging said slurry billet from said vessel, directly and immediately, into a shot sleeve of a casting machine, without any intermediate stage of holding said slurry billet between said vessel and said shot sleeve and without any reheating step subsequent to said discharging from said vessel.

35. (Amended) A method of producing on-demand, semi-solid material for a casting process, said method comprising the following steps:

heating a metal alloy until it reaches a molten state;

transferring an amount of said metal alloy, while in said molten state, to a vessel;

assembling a covering cap to said vessel in order to permit the use of an inert gas to control contamination;

cooling said amount of metal alloy in said vessel;

applying an electromagnetic field to said amount of metal alloy by the use of a stator for stirring said metal alloy within said vessel while said cooling continues in order to create a slurry billet of the desired thixotropic solid to liquid ratio for casting, a voltage being applied to said stator, the level of said voltage determining the stirring torque applied to said metal alloy; and

discharging said slurry billet from said vessel, directly and immediately, into a shot sleeve of a casting machine, without any intermediate stage of holding said slurry billet between said vessel and said shot sleeve and without any reheating step subsequent to said discharging from said vessel.

37. (Amended) A method of producing on-demand, semi-solid material for a casting process, said method comprising the following steps:

heating a metal alloy until it reaches a molten state;

153 clamping a thermal jacket around an alloy-receiving vessel;

transferring an amount of said metal alloy, while in said molten state, to said vessel;

cooling said amount of metal alloy in said vessel;

applying an electromagnetic field to said amount of metal alloy for creating a flow pattern of said metal alloy within said vessel while said cooling continues in order to create a slurry billet of the desired thixotropic solid to liquid ratio for casting; and

discharging said slurry billet from said vessel, directly and immediately, into a shot sleeve of a casting machine, without any intermediate stage of holding said slurry billet between said vessel and said shot sleeve and without any reheating step subsequent to said discharging from said vessel.

38. (Amended) A method of producing on-demand, semi-solid material for a casting process, said method comprising the following steps:

heating a metal alloy until it reaches a molten state;

153 arranging a plurality of stators around an alloy-receiving vessel, said plurality of stators including at least one rotary stator in combination with at least one linear stator;

transferring an amount of said metal alloy, while in said molten state, to said vessel;

cooling said amount of metal alloy in said vessel;

applying an electromagnetic field to said amount of metal alloy for creating a flow pattern of said metal alloy within said vessel while said cooling continues in order to create a slurry billet of the desired thixotropic solid to liquid ratio for casting; and

discharging said slurry billet from said vessel, directly and immediately, into a shot sleeve of a casting machine, without any intermediate stage of holding said slurry billet between said vessel and said shot sleeve and without any reheating step subsequent to said discharging from said vessel.